Instructor: Leo Goldmakher

NAME (LAST, NICKNAME): _____

SECTION # (10AM = 1, 11AM = 2): _____

Williams College
Department of Mathematics and Statistics

MATH 200 : DISCRETE MATH

Problem Set 3 – due Thursday, February 21st

INSTRUCTIONS:
This assignment must be turned in to my mailbox (on the right as you enter Bascom) by **4pm** sharp. Late assignments may be submitted at the beginning of Friday's class to me in person (i.e. don't leave them in my mailbox or ask someone else to submit on your behalf); however, 5% will be deducted for late submission. *Assignments submitted later than start of class on Friday will not be graded.*

Please print and attach this page as the first page of your submitted problem set.

PROBLEM	**GRADE**
3.1	
3.2	
3.3	
3.4	
3.5	
3.6	
3.7	
3.8	
Bonus	
Total	

Please read the following statement and sign **before writing the final version of this problem set:**

I understand that I am not allowed to use the internet to assist with this assignment, apart from accessing the course website or looking up definitions. I also understand that I must write down the final version of my assignment in isolation from any other person, and to not copy from any set of written notes created when another person was present. I pledge to abide by the Williams honor code.

SIGNATURE:_____

Problem Set 3

3.1 For each of the following choices of P, determine whether P is a proposition. Briefly justify your answer.

(a) $2 + 3 = 5$

(b) $1 + 1 = 3$

(c) Wherefore art thou Romeo?

(d) The digit 7 appears infinitely many times in the decimal expansion of π.

(e) $x^2 + 1$

(f) $x^3 - 3x + 2 = 0$

(g) Either P or $\neg P$ is false. [*Recall that P denotes the name of the sentence itself.*]

(h) P is a proposition.

3.2 Is it possible for a conditional and its converse to simultaneously be false? Either give an example, or prove that this can't happen.

3.3 Wikipedia states the Pythagorean theorem in the following form: "*[In a right triangle,] the square of the hypotenuse (the side opposite the right angle) is equal to the sum of the squares of the other two sides.*"

(a) Rewrite this statement in the form of a conditional.

(b) What is the converse of the Pythagorean theorem? Do you think it's true? (No proof necessary, but think about it a bit.)

3.4 Each of the following is a conditional statement (although potentially not explicitly written in if-then form). For each, write its converse and contrapositive, and decide whether each is true.

(a) If you're on the Williams campus, then you're in Williamstown.

(b) Every prime number is larger than 1.

(c) The sum of two odd numbers is even.

3.5 Write a truth table for $((\neg P) \vee Q) \iff (P \wedge Q)$. [*Truth tables of $\wedge$ and $\vee$ are given on page 12 of the book.*]

3.6 Find a way to express $\implies$ in terms of just $\neg$ and $\vee$. (In other words, find a proposition that only uses $\neg$ and $\vee$ that's logically equivalent to the proposition $P \implies Q$.) Justify your answer using a truth table.

3.7 The logical connective *exclusive or* (written *xor* for short) plays a very important role in computer science, and is defined as follows: P *xor* Q is true if exactly one of P or Q is true, and is false otherwise.

(a) Write a truth table for *xor*.

(b) Express *xor* in terms of $\wedge$, $\vee$, $\implies$, $\neg$, and justify your answer with a truth table.

3.8 We've seen that $\implies$ can be expressed in terms of $\neg$ and $\vee$.

(a) Express $\wedge$ in terms of $\neg$, $\vee$, and $\implies$, and justify your answer.

(b) Can you express $\wedge$ in terms of just $\neg$ and $\vee$? Justify your answer.

3.9 (*Bonus problem*) Find an example of a news article in which a conditional proposition is used interchangeably (and, thus, incorrectly!) with its converse.